

# A Clinical Informatics Network (CLINT) To Support the Practice of Evidence-Based Health Care

K.B. Langton, MSc, BEd, J. Horsman, BA,  
R.S.A. Hayward, MD, MPH, S.A. Ross, BASc

Health Information Research Unit  
McMaster University Medical Center, Hamilton, Ontario L8N 3Z5

*CLINT, which stands for Clinical Informatics NeTwork, is one of the clinical informatics initiatives in development at McMaster University's Health Information Research Unit. CLINT is a microcomputer-based system of over 60 workstations providing 24 hour availability of a set of clinical information resources to clinicians throughout our teaching hospital. CLINT encompasses three domains: (1) a user adaptable clinician-computer interface, (2) unique, evidence-based health care content, and (3) automated data collection and viewing tools. An objective of the CLINT project is to determine CLINT's impact on the practice of health care. Early analysis of our data has revealed that over the past year, there has been widespread use of CLINT by clinicians from all clinical domains. Our next task is to evaluate CLINT's usefulness.*

## INTRODUCTION

Today's health-care professionals are becoming increasingly aware of the immense quantity of available information; some good, some bad, but in many cases overwhelming.<sup>1</sup> Modern clinicians need ways to access the best information in the shortest amount of time.

The Clinical Informatics NeTwork (CLINT) is a system of networked, PC-based computer workstations that provide users with clinical information tools.<sup>2,3</sup>

The goal of the CLINT project is to enable evidence-based health care by providing clinicians with high quality information tools in actual health care practice settings. In the first phases of this project, we were evaluating acceptability, usefulness, and durability of electronic information tools on a busy internal medicine teaching service. During the next phases, we are evaluating how CLINT affects clinical practices and health outcomes.

CLINT was deployed in May on 1994 as a centralized system of 5 networked computer workstations on a internal medicine ward. Now, in mid 1996, CLINT is available on more than 60 workstations throughout this teaching hospital and its sister hospital on a 24 hour basis on many wards, clinics and clinician offices, including the emergency rooms and intensive care units.

## SYSTEM DESCRIPTION

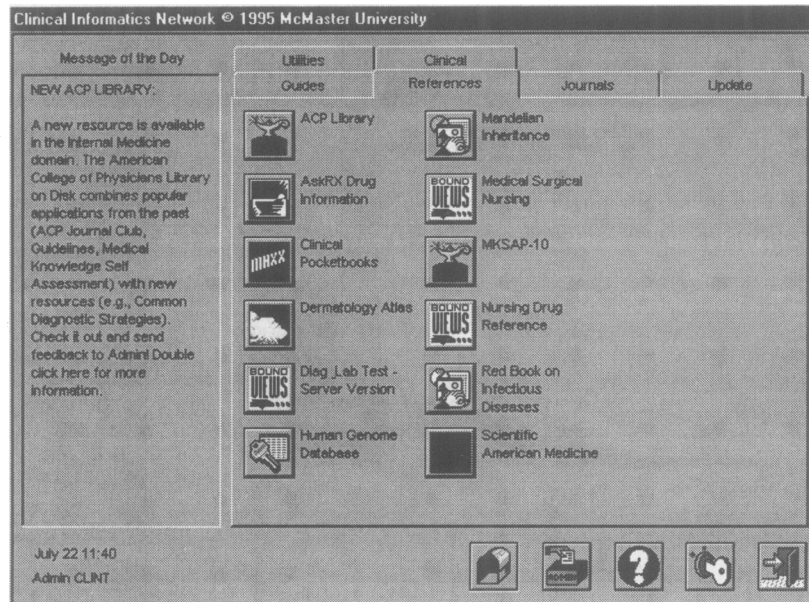
We have developed a multi-tasking, graphical user interface for stand-alone or networked *Windows*-compatible computers that facilitates rapid, simple, and secure access to user-specific suites of clinical, academic and administrative information tools.

CLINT has been tested and is used with Microsoft Windows NT, Windows for Workgroups, and Windows 95 operating systems. We have tested and are using CLINT on both Windows NT and Novell networks.

The CLINT system encompasses three domains: (1) a user-adaptable **human-computer interface**, (2) unique, evidence-based, clinical information **content**, and (3) automated **data collection** that gathers information about how users interact with and react to CLINT.

### User-adaptable Interface

The CLINT interface provides different types of users with user-specific appearances and user-skill-based clinical information tools. For example, the CLINT interface (see figure 1) is clinician (e.g., internist, pediatrician, nurse, student, pharmacists etc.) and expertise (beginner, intermediate, advanced) specific. Each different user type has specific information needs, so we make available those clinical resources which are appropriate for that particular user domain. Within each user domain, as



**Figure 1- CLINT Main Application Panel**

users become more proficient, CLINT advances them to levels with more sophisticated sets of information tools.

The rationale for limiting resources was that we did not want to overwhelm new users with too many or too sophisticated tools at the beginning of their CLINT experience. The cognitive load involved with learning any new system can be quite taxing. However, at predetermined times (which are completely adjustable), users are given the option of moving up to the next level.

#### **Evidence-based Health Information**

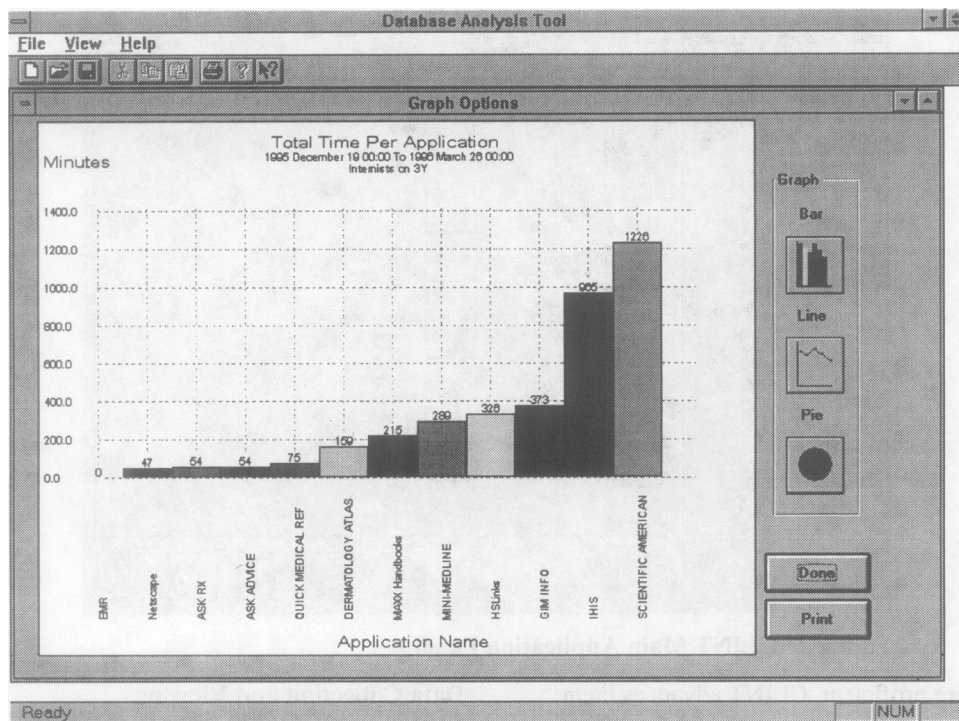
Unique, evidence-based, information resources (e.g. ACP Journal Club - structured abstracts of the best available clinical studies for general medicine, abstracts of clinical practice guidelines, medical knowledge self-assessment tools, users guides to the medical literature) have been developed here at the Health Information Research Unit. These resources are integrated into CLINT along with a collection of commercially available products (e.g. electronic medical textbooks and handbooks, drug information databases, a dermatology atlas), institutional databases (e.g. patient's laboratory test results, on-line discharge summaries), links to other communications networks providing various services (e.g. Medline, Netscape), and an on-line evidence-based informatics curriculum. One of the aims of this research is to determine which evidence-based tools are the most used and the most useful.

#### **Data Collection and Viewing**

CLINT collects data by two methods: 1) through automated presentation of computerized intake

(baseline) and interval (follow-up) surveys (generated by GAP<sup>4</sup>), and 2) a "silent" data-collection system that gathers information about user choices of applications, actions, and queries. CLINT knows who's logged onto which computer, at what time of day, how long they are on for, what programs they are using, and it captures user keystrokes (all users are aware of the data collection and consent to its use after identifiers are removed).

CLINT administrators can analyze and view usage data generated by CLINT. At the click of a button, results can be instantly graphed, providing feedback on system utilization. This information can be used for presentations, teaching, quality improvement and software purchasing decisions (see figure 2). The figure indicates that Scientific American Medicine was the most popular resource, followed closely by IHIS (health information services) which provides access to the hospitals' clinical information databases. A new homegrown application called EMR (for "electronic medical record") has recently been made available throughout the hospital. We expect usage of this product to overtake IHIS in the near future.



**Figure 2 - CLINT Data Viewing Tool**

## USER INTERACTIONS WITH CLINT

In 1992, a medical information needs survey (MINS) was conducted at 4 teaching hospitals to assess Internists' current and projected work-place computer usage. Internists in general internal medicine at McMaster University Medical Centre, University of Alberta Division of General Internal Medicine, Bowman Gray School of Medicine in North Carolina, and Johns Hopkins Francis Scott Key Medical Center in Baltimore-completed 266 of these medical information needs questionnaires.

This pen and paper questionnaire served as the basis for what we call the CLINT medical 'Intake' (a.k.a. Baseline) survey that all new users to the McMaster CLINT system must complete during their first log-on. For comparisons here, only the McMaster MINS and McMaster CLINT data will be shown. Computer ownership has increased by almost 20% in the 3 years between surveys. In 1992, 67% of internists owned or had access to a personal computer. By November 1995, that figure had grown to almost 87%. Table 1, shows current and expected computer use amongst internists in 1992 and again in 1995.

By November 1995 there were 154 general medical internists at McMaster registered on the CLINT system including 68 medical students and 86

housestaff/preceptors. Each had access to as many as 16 applications depending on their level of CLINT experience.

Figure 3 shows the use of the various applications available on CLINT in 1995.

## DISCUSSION AND FUTURE

We have implemented a clinical informatics system in a teaching hospital and have successfully taught nurses and physicians how to use it. During this experience, silent data collection recorded participants reactions to the system and their use of CLINT.

CLINT started as a small local area network of nine workstations on an internal medicine ward in a teaching hospital. The CLINT system is now also being used in the pediatrics wards, family practice unit, emergency rooms, intensive care and neonatal intensive care units, several clinicians offices, and the urgent care center at a nearby hospital. There are plans to further deploy CLINT throughout the rest of the hospital and across the city. Additionally, Bowman Gray School of Medicine in North Carolina was recently set up with CLINT in their internal medicine department.

**Table 1: A-F. Current and Expected computer usage in 1992 and 1995.** The 1<sup>st</sup> number in each cell is the percentage of internists who currently use the specified computer application and the 2<sup>nd</sup> number is the percentage who expect to use that application 5 years hence.

**Current/Expected Computer Usage:**

**A. Word Processing**

	Yearly	Mnthly	Weekly	Daily
1992	27/6	27/15	27/36	18/42
1995	16/8	32/8	41/43	11/41

**B. Test Retrieval/Review**

	Yearly	Mnthly	Weekly	Daily
1992	29/3	3/3	10/19	58/75
1995	16/8	3/-	22/27	60/65

**C. Electronic Medical Records**

	Yearly	Mnthly	Weekly	Daily
1992	69/10	6/10	9/27	16/53
1995	76/22	5/3	11/19	8/57

**D. Decision Support Software**

	Yearly	Mnthly	Weekly	Daily
1992	80/13	3/19	13/47	3/22
1995	84/19	5/5	8/49	3/27

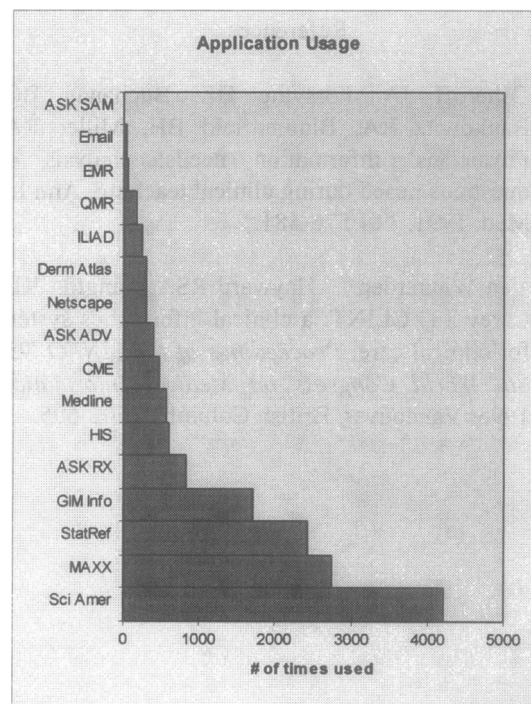
**E. Computer Drug References**

	Yearly	Mnthly	Weekly	Daily
1992	50/9	20/15	30/49	-/-
1995	71/19	19/11	11/41	-/30

**F. Medical Literature Searching**

	Yearly	Mnthly	Weekly	Daily
1992	6/-	38/9	47/61	9/30
1995	17/11	27/11	51/46	5/32

Data from the above and other implementations of the CLINT system can assist decision-makers in planning information systems for other health care settings. The results of CLINT experiments will instruct about the types and magnitude of change in provider behavior that may be attributed to informational interventions. The use of up-to-date evidence-based clinical information tools may improve the quality of health care decisions.



**Figure 3: CLINT application usage in 1995.**

Through the analysis of our collected data regarding user preferences and usage patterns, we shall build better user models to closer represent the specific needs of clinicians. In addition to these enhancements through the use of user modeling, we plan on implementing intelligent agents (or wizards) to assist administrators while installing and setting up CLINT systems. Other wizards will direct users to the best tools to match their specific informational challenges. These features will make CLINT even more adaptable to the special needs of information intensive work places. Additional findings are described on the World Wide Web (<http://hiru.mcmaster.ca/CLINT/default.htm>)

While we still have much work to do, we are now in a position to continue research and development in an informatics laboratory that doubles as a widely used information service.

**Acknowledgments**

This work was supported in part by Bayer Pharmaceuticals, Digital Equipment Corporation, Microsoft Corporation, Chedoke-McMaster Hospitals and McMaster University.

### References

1. Osheroff JA, Forsythe DE, Buchanan BG, Bankowitz RA, Blumenfield BH, Miller RA. Physicians' information needs: analysis of questions posed during clinical teaching. *Ann Int Med*, 1991; 114:576-581.
2. Van Wingerden L, Hayward RSA, Langton KB, Carey TT. CLINT: a clinical informatics system for clinical care. *Proceedings of MEDINFO '95: 8th World Congress on Medical Informatics*, 1995; Vancouver, British Columbia. 602-605.
3. Hayward RSA, Langton KB, Nahirny M, Hogeterp J. The clinical informatics network (CLINT). *Proceedings of the Nineteenth Annual Symposium on Computer Applications in Medical Care*, 1996; 19:991.
4. Hayward, RSA, Hogeterp, JA, Langton, KB, Summerell, D, Roizen, MF 1995. GAP: a computer-assisted design tool for the development and analysis of evidence-based automated questionnaires. *Proceedings of MEDINFO '95: 8th World Congress on Medical Informatics*, Vancouver, British Columbia. 934-937.